

Parents Perceive Improvements in Socio-emotional Functioning in Adolescents with ASD Following Social Skills Treatment

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Abstract The current study examined the effectiveness of a social skills treatment (PEERS) for improving socio-emotional competencies in a sample of high-functioning adolescents with ASD. Neuropsychological and self- and parent-report measures assessing social, emotional, and behavioral functioning were administered before and after treatment. Following social skills treatment, adolescents with ASD exhibited decreased aggression, anxiety, and withdrawal, as well as improvements in emotional responsiveness, adaptability, leadership, and participation in activities of daily living, though no change was found in affect recognition abilities. These findings suggest that PEERS social skills treatment improves particular aspects of emotional, behavioral, and social functioning that may be necessary for developing and maintaining quality peer relationships and remediating social isolation in adolescents with ASD.

Keywords Autism spectrum disorder · Social skills treatment · PEERS · Adolescents

Introduction

ASD is a neurodevelopmental disorder characterized by deficits in social communication, social interaction, and restricted and repetitive patterns of behavior (APA 2013). Clinical presentations of the disorder are highly

heterogeneous with substantial individual variability in symptom presentation and severity, as well as the degree of accompanying intellectual, language, and functional impairment (Geschwind 2009). Despite such variability, social deficits are regarded as the hallmark impairment of ASD and typically manifest as difficulty with socio-emotional cognition, verbal and nonverbal communication, and interpersonal relationships (APA 2013). Examples of such deficits include a lack of social reciprocity, difficulty interpreting social cues and nonliteral language, impairments in social attention, motivation, and orienting, deficits in joint attention, poor speech prosody, limited eye contact, and problems with empathy and perspective-taking (Bonneh et al. 2011; Dawson et al. 2004, 2005; Gaigg 2012). The pervasive social deficits that characterize ASD result in significant challenges developing and maintaining interpersonal relationships and often lead to social withdrawal and isolation (Bellini et al. 2007).

A variety of behavioral interventions have demonstrated effectiveness with regard to improving current functioning and mediating outcomes in youth with ASD (Dawson and Burner 2011). For example, early comprehensive, parent-mediated, and targeted behavioral interventions have demonstrated some degree of effectiveness with regard to enhancing the cognitive abilities, language development, and functional adaptive behaviors of children and adolescents with ASD (Dawson and Burner 2011; Magiati et al. 2012; Reichow 2012). Behavioral interventions (e.g., systematic desensitization, applied behavioral analysis) have also been proven efficacious for reducing concomitant anxiety and aggressive behavior in youth with ASD (Dawson and Burner 2011). Despite some success targeting certain representative behaviors and associated features of ASD, improving social deficits remains a significant treatment challenge (Laugeson et al.

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2012; Magiati et al. 2012). For example, persistent deficits in reciprocal conversational skills represent a prominent area of social difficulty for youth with ASD (Chang et al. 2013).

Given the persisting nature of social deficits in ASD, adolescence poses unique developmental challenges for this population. At a time when social acceptance is of particular importance, adolescents with high-functioning ASD become more aware of the social difficulties they encounter during peer interactions and often find themselves rejected or bullied at school (Tse et al. 2007). Further, teens with ASD report more loneliness and poorer quality friendships compared to their typically developing (TD) peers in regular education classrooms (Bauminger and Kasari 2000). Although the transition into adolescence and adulthood has been associated with enhanced language abilities, pervasive abnormalities in verbal and nonverbal social communication markedly impair prospects for social integration across the lifespan, further reducing the quality of life for individuals with ASD (Levy and Perry 2011; Magiati et al. 2014). These social challenges are particularly problematic given the increasing prevalence of ASD among adolescents with average to above average cognitive functioning and emphasis on including students with neurodevelopmental disorders in mainstream classrooms (White et al. 2007).

Social skills interventions are currently the most widely used and well supported of all treatment approaches for adolescents with ASD (Lerner et al. 2012; Tierney et al. 2014). Although results have been mixed, there is a growing body of evidence supporting the efficacy of social skills interventions for adolescents with ASD (Miller et al. 2014; Reichow 2012; White et al. 2007). In particular, support has grown for adult-led, didactic skills approaches relative to more naturalistic, activity-based interventions (Kasari et al. 2016). Specific treatment effects that have been documented include enhanced peer relationships, increased social engagement, reduced social anxiety, and improvements in basic social competencies such as social reciprocity, recognition of affect, social pragmatics, social problem solving, interpretation of social cues, and perspective-taking (Bohlander et al. 2012; Dawson and Burner 2011; Laugeson et al. 2012; Rao et al. 2008; Tierney et al. 2014; Walton and Ingersoll 2013; White et al. 2013). Intervention strategies that have demonstrated the largest effects include behavioral modeling, behavioral rehearsal, coaching, and performance feedback. Most are conducted in a small-group setting with an emphasis on peer interaction (Dawson and Burner 2011). Although many social skills programs incorporate parent/caregiver education and training in their curriculum, few programs use a parent-assisted model of social skills instruction (McMahon et al. 2013). In addition, the generalization and maintenance of learned social skills into naturalistic settings is a recurring

weakness for all types of social skills interventions (Bohlander et al. 2012; Rao et al. 2008; White et al. 2007).

However, the Program for the Education and Enrichment of Relational Skills (PEERS; Laugeson and Frankel 2010) explicitly addresses the translation of learned social skills into naturalistic settings through the structured involvement of parents/caregivers and inclusion of generalization strategies. The PEERS treatment emphasizes skills that are essential for developing and maintaining quality peer relationships and remediating social isolation. Specific skills taught include conversational skills, social entry and exiting skills, social networking skills, and socially appropriate affective and behavioral responses to peer rejection and/or bullying (Van Hecke et al. 2013; Laugeson et al. 2009). The efficacy and effectiveness of the PEERS treatment for adolescents with ASD has been established through multiple randomized controlled trials (RCTs; Laugeson et al. 2014). Laugeson et al. (2009) conducted the first RCT investigating the effectiveness of PEERS treatment. They found, relative to a delayed-treatment or “wait list” control group, adolescents with ASD in the treatment condition showed significantly enhanced social knowledge, increased social engagement, and overall improvement in social skills. Social skill change was indexed by the Social Skills Rating System (SSRS; Gresham and Elliott 1990). A follow-up investigation replicated and extended these results, demonstrating that treatment gains in social communication, social motivation, and repetitive behavior were maintained 14 weeks post-intervention (Laugeson et al. 2012). More recently, Schohl et al. (2014) conducted an independent RCT replication of PEERS and found positive treatment effects similar to those observed in prior studies. In a related study, Chang et al. (2013) examined the predictors of positive social skills outcomes and concluded that higher baseline parent-reported social skills and lower self-perceived social functioning predicted overall improvement in social skills following participation in PEERS. Additionally, Yoo et al. (2014) provided support for the cross-cultural validity of the PEERS program, and Mandelberg et al. (2014) demonstrated the maintenance and extension of treatment gains 1–5 years post-intervention, with additional improvements in social functioning at follow-up assessment.

While there is an emerging body of literature examining outcomes in adolescents with ASD following social skills treatment, prior studies have largely focused on specific aspects of social functioning (e.g., social engagement, social pragmatics), and few have assessed broader social behaviors (e.g., externalizing/internalizing behaviors), as well as social functioning outside of the treatment setting. In addition, few studies have examined the possible underlying mechanisms for the many socio-emotional and behavioral problems associated with ASD, including deficits in

facial emotion recognition and emotion regulation (e.g., poor emotional control, amplified emotional responses; Mazefsky et al. 2013). Thus, there is a clear need to more comprehensively evaluate treatment outcomes and document the effects of PEERS on both broader areas of socio-emotional functioning and on affect recognition and emotion regulation deficits in adolescents with ASD. Further, more research is needed on the efficacy and effectiveness of social skills treatments such as PEERS that incorporate parent-assisted social skills instruction in order to investigate the extent to which parent involvement improves outcome generalizability. Thus, the purpose of the current study was to investigate the effectiveness of the PEERS program for improving socio-emotional competencies in adolescents with ASD. It was predicted that (a) adolescents with ASD, relative to matched comparisons with typical development (TD), will display clinically significant differences in social and emotional functioning measured at pre-treatment, (b) the 14-week parent-mediated PEERS treatment will have positive effects on the socio-emotional functioning of adolescents with ASD, and (c) the socio-emotional functioning of adolescents with ASD would more closely approximate that of their TD peers measured at post-treatment.

Method

Participants

Participants included sixteen adolescents ages 12–17 ($M = 15.07$, $SD = 1.40$) who were previously diagnosed with ASD by medical professionals using established criteria. Adolescents with ASD enrolled in PEERS social skills treatment at a university-based children’s hospital in a large metropolitan area were recruited for the current study. Thirteen adolescents ages 12–17 ($M = 15.57$, $SD = 1.77$) with TD were matched to the first group on age, gender, and level of education. Adolescents with TD were recruited from the broader St. Louis community through word of mouth. Demographic variables for both groups are presented in Table 1. Data regarding parents’ level of education and socio-economic status was not

Table 1 Mean demographic variables for ASD and TD groups (standard deviations are in parentheses)

	ASD ($n = 16$)	TD ($n = 13$)	Statistic (t_{27})
Age	15.07 (1.40)	15.57 (1.77)	0.85
Male (%)	75.00	61.50	0.76
Caucasian (%)	87.50	92.30	0.72
Years of Ed	8.44 (1.50)	9.15 (1.72)	1.19
Right-handed (%)	81.30	92.3	-0.84

collected. However, the majority of families had private insurance coverage, and in cases when families voiced that they were unable to pay high insurance deductibles or insurance coverage was denied, a private foundation covered social pragmatic communication treatment expenses. The Gilliam Autism Rating Scale—Third Edition (GARS-3) was used to confirm the presence or absence of ASD symptomatology in the respective groups (Table 2).

Adolescents with TD were excluded from study participation if they had current or previously diagnosed psychiatric, cognitive, motor, sensory, or language disorders. However, given the prevalence of psychiatric and health comorbidities in ASD (APA 2013), adolescents with ASD and comorbid psychiatric conditions were not excluded from the study. As a result, 12 of the 16 participants with ASD (75%) were reported to have comorbid psychiatric conditions, and 6 of the 17 (37.5%) were prescribed psychotropic medication. Comorbid psychiatric diagnoses and associated medications are listed in Table 3. To maintain consistency with eligibility criteria for the PEERS treatment, youth were screened for intellectual disability, and no participants met or exceeded criteria (e.g., ≤ 70 estimated Full-Scale Intelligence Quotient [FSIQ-2] + poor adaptive functioning). Results of intellectual and adaptive functioning estimates are presented in Table 2. The groups were significantly different with regard to adaptive skills but not intellectual ability. All participants were accompanied by a parent or legal guardian who provided consent and parental report of their child’s functioning. All parents were motivated and agreed to coach and attend treatment at the intake meeting.

Table 2 Mean results of ASD and intellectual disability screening for ASD and TD groups (standard deviations are in parentheses)

	ASD ($n = 16$)	TD ($n = 13$)	Statistic (t_{27})
GARS-3 autism index score ^a	93.63 (11.58)	50.23 (3.19)	-13.07***
Unlikely (%)	0	100	
Probable (%)	0	0	
Very likely (%)	100	0	
WASI-II FSIQ-2 ^b	95.56 (14.45)	103.54 (10.80)	11.02***
Range	75–125	86–123	
ABAS-II GAC ^c	66.50 (11.37)	109.23 (9.01)	-13.07***
Range	49–87	94–120	

*** $p \leq .001$

^aGilliam autism rating scale—third edition

^bWechsler abbreviated scale of intelligence—second edition FSIQ-2

^cAdaptive behavior assessment system—second edition general adaptive composite

Table 3 Comorbid psychiatric diagnoses and medications for ASD group (number of adolescents endorsing each diagnosis or medication is in parentheses)

Attention deficit/hyperactivity disorder (9)
Stimulant (6)
Anxiety (3)
Specific learning disorder (2)
Phobia (1)
Oppositional defiant disorder (1)
Posttraumatic stress disorder (1)
Depression (1)
Semantic-pragmatic language disorder (1)

Materials and Procedure

Following attainment of assent and consent, adolescents in both groups were assessed using cognitive measures and questionnaires incorporated into a short battery. To assess cognitive function, adolescents were administered the two-subtest form (Vocabulary and Matrix Reasoning subtests) of the Wechsler Abbreviated Scale of Intelligence—Second Edition (WASI-II; Wechsler 2011). The WASI-II is an individually-administered measure of cognitive ability for individuals ages 6–90, assessing verbal and nonverbal intellectual abilities. The two-subtest form of the WASI-II (Vocabulary and Matrix Reasoning) was used to provide a brief estimate of participants' general intellectual ability (FSIQ-2). Adolescents were also administered the Affect Recognition subtest from A Developmental Neuropsychological Assessment—Second Edition (NEPSY-II; Korkman et al. 2007), which is an individually-administered measure of neuropsychological development for children and adolescents ages 3–16. This subtest assesses youth's ability to recognize the affect of children's faces and progresses from identification of affect to recognition memory for affect.

In addition, adolescents were administered two standardized self-report measures. The Emotion Regulation Index for Children and Adolescents (ERICA; MacDermott et al. 2010) is a 16-item self-report inventory designed to measure emotion regulation in children and adolescents ages 9–16. Responses pertain to youths' ability to regulate their emotions and were measured on a 5-item Likert scale, culminating in an Emotion Regulation Index score. The Positive and Negative Affect Schedule for Children (PANAS-C; Watson et al. 1988) is a 27-item self-report inventory designed to measure current (state) positive and negative mood in school-age children and adolescents. The frequency with which youth endorsed recently experiencing varying mood states on a 5-item Likert scale yield positive and negative affect subscale scores, indicative of youths' level of enthusiasm, activeness, and alertness, as well as their level of subjective distress.

Finally, a parent or legal guardian of each adolescent participant completed four standardized questionnaires to provide information regarding adolescents' overall functioning (e.g., cognitive, behavioral, social, emotional, adaptive) and autism severity. For assessment of broad behavioral functioning, adults completed the Behavior Assessment System for Children—Second Edition Parent Rating Scale (BASC-2 PRS; Reynolds and Kamphaus 2004), which evaluates social, emotional, adaptive, and behavioral functioning in children and adolescents and yields eight clinical subscales, three clinical composite scores, and four adaptive scales. Parents also completed the Positive and Negative Affect Schedule for Children (PANAS-C-P; Ebesutani et al. 2011), a 27-item informant-report inventory designed as an adjunct to the PANAS-C to measure parental report of current (state) positive and negative mood in youth ages 8–18. In order to assess current adaptive functioning, adult raters also completed the Adaptive Behavior Assessment System—Second Edition (ABAS-II Parent Form 5–21; Harrison and Oakland 2003), a multi-method system used to evaluate adaptive behavior in individuals across the lifespan. Parents rated the presence and frequency of adolescents' adaptive behaviors on a 4-item Likert scale and responses yielded ten adaptive subscales, three composite scores, and a General Adaptive Composite total score. Additionally, parents completed the Gilliam Autism Rating Scale—Third Edition (GARS-3; Gilliam 2014) as a measure of the presence and severity of ASD symptomatology. The GARS-3 is a 56-item informant-report inventory intended to estimate the probability that individuals ages 3 to 22 meet diagnostic criteria for ASD. Responses pertain to current behaviors and are measured on a 4-item Likert scale. The probability of ASD (known as the autism index; $M=100$; $SD=15$) is calculated by summing scores from the restrictive/repetitive behaviors, social interaction, social communication, emotional responses, cognitive style, and maladaptive speech subscales. Finally, a brief demographic questionnaire was used to collect information regarding adolescents' age, gender, handedness, years of education, psychiatric diagnoses, and medications. Given that the groups were matched on age and gender, we chose to focus our analyses on raw scores generated for all measures.

PEERS Social Skills Treatment

The PEERS program is a manualized, parent/caregiver-assisted social skills treatment for adolescents with social deficits that represents a structured learning approach to the acquisition and maintenance of social skills (McMahon et al. 2013). Adolescents and their parents/caregivers attend separate but concurrent 90-minute sessions delivered once a week for 14 weeks in a small to medium group setting (Laugeson et al. 2009). Multiple homework

assignments, which are facilitated by parent coaching, are completed on a weekly basis. Each group session consists of a review of homework, parent and teen didactic lessons, modeling appropriate behavior, and role-playing. Each lesson targets distinct social skills necessary for navigating social environments, with particular emphasis on skills that are essential for developing quality peer relationships and remediating social isolation, such as conversational skills, understanding social cues, and handling socially appropriate affective and behavioral responses to peer rejection and/or bullying (Laugeson et al. 2009; Van Hecke et al. 2013).

Follow-Up Session Procedures

Adolescents in the ASD group were recruited for a follow-up study session to determine the effects of PEERS treatment on their socio-emotional functioning. One participant did not complete the 14-week treatment program, and therefore was not re-contacted, and an additional two participants declined participation (voluntary attrition: 13%). As a result, 13 youth returned for a second study session within 19 weeks of completing PEERS treatment (weeks since completion: $M=7.24$, $SD=5.15$). Of the 14 weekly PEERS sessions, participants attended an average of 12.38 sessions ($SD=0.87$), and completed homework for an average of 8.46 sessions ($SD=3.18$). A parent was in attendance for an average of 12.23 sessions ($SD=0.93$), with one parent consistently attending sessions. The procedures for the follow-up study session were identical to those for the first, with the exception that the WASI-II was not re-administered, as intellectual capacity was expected to remain stable.

Study Design

Study hypotheses were examined using a combined between- and within-subjects design. Specifically, TD adolescents were assessed at a single time point while adolescents with ASD were assessed at two time points (pre- and post-PEERS treatment). Independent samples *t*-tests were conducted to compare pre-intervention neuropsychological performance and parent-/self-report measures in adolescents with ASD relative to their TD peers. Paired samples *t*-tests analyses were conducted to examine effects of the PEERS treatment on neuropsychological performance and parent-/self-report measures in adolescents with ASD. In order to examine the clinical significance of post-intervention changes, follow-up independent samples *t*-tests were conducted for measures that displayed significant differences pre- to post-treatment in the ASD group, in order to compare post-treatment scores to respective scores obtained by TD peers.

Results

Affect Recognition

Contrary to hypotheses, adolescents with ASD did not demonstrate impaired performance on the NEPSY-II Affect Recognition subtest relative to their TD peers. Raw scores (presented in Table 4) were compared for the ASD and TD groups, and no significant differences were found, $t(27)=0.78$, $p=.44$. Comparisons between performance on the NEPSY-II Affect Recognition subtest at baseline and performance post-intervention were also conducted for adolescents with ASD. Again, contrary to hypotheses, participation in the PEERS treatment did not improve performance on the NEPSY-II Affect Recognition subtest relative to baseline, $t(12)=-0.87$, $p=.40$.

Positive and Negative Affect

Consistent with hypotheses, parental report of adolescents' positive and negative affect was significantly different between adolescent groups, with parents reporting lower levels of positive affect and higher levels of negative affect in adolescents with ASD relative to their TD peers ($t=4.88$, $p<.001$; $t=-3.36$, $p<.05$, respectively). However, comparisons between parent ratings before and after participation in the PEERS program did not yield differences in positive or negative affect, $t(12)=-0.34$, $p=.73$; $t(12)=1.62$, $p=.13$, respectively. Contrary to this finding, adolescents with ASD did not demonstrate significant differences in self-reported negative affect on the PANAS-C relative to their TD peers, $t(27)=-1.37$, $p=.18$; however, a trend effect was observed in the predicted direction for positive affect scores, $t(27)=1.97$, $p=.06$. Similarly, adolescents with ASD did not exhibit differences in self-reported positive or negative affect after participation in the PEERS treatment, $t(12)=-0.47$, $p=.65$; $t(12)=-0.41$, $p=.70$, respectively. Results are presented in Table 4.

Emotion Regulation

Contrary to hypotheses, adolescents with ASD did not demonstrate significant differences in self-reported emotion regulation abilities as measured by the ERICA relative to TD peers (see Table 4). Specifically, significant differences were not observed for the Emotion Regulation Index score or the Emotional Control or Situational Responsiveness subscales, $t(27)=0.80$, $p=.43$; $t(27)=1.34$, $p=.19$, respectively, although a trend effect was observed in the predicted direction for the Self Awareness subscale, $t(27)=1.95$, $p=.06$. Participation in the PEERS program did not result in significant changes to self-reported emotion regulation skills, as no differences were observed for the ASD group

Table 4 Raw scores for neuropsychological and parent/self-REPORT Measures of emotional functioning for ASD and TD groups

	ASD pre-test		ASD post-test		TD controls		Comparison (<i>t</i>)		
	Mean	SD	Mean	SD	Mean	SD	Pre-TD	Pre-Post	Post-TD ^a
NEPSY-II: Affect recognition (total)	25.69	4.72	26.69	3.90	27.38	3.04	0.78	-0.87	-
PANAS-C: Positive affect	40.00	12.72	40.92	11.03	46.08	5.14	1.97	-0.47	-
PANAS-C: Negative affect	28.92	8.22	29.77	9.80	24.92	6.64	-1.37	-0.41	-
PANAS-C-P: Positive affect	34.15	7.44	34.85	9.70	46.54	6.73	4.88***	-0.34	-
PANAS-C-P: Negative affect	31.54	11.18	26.62	8.95	21.08	6.38	-3.36*	1.62	-
ERICA: Emotional control	22.38	6.02	22.62	5.41	24.38	5.38	0.80	-0.12	-
ERICA: Self awareness	17.69	3.28	17.08	3.17	19.62	2.50	1.96	0.94	-
ERICA: Situational responsiveness	16.85	1.77	16.54	1.81	17.85	1.41	1.34	0.77	-

NEPSY-II nepsy—second edition, PANAS-C the positive and negative affect schedule for children, PANAS-C-P the positive and negative affect schedule for children—parent report form, ERICA the emotion regulation index for children and adolescents

* $p < .05$

** $p < .01$

*** $p < .001$

^aComparisons conducted when variables demonstrated significant pre-/post-intervention changes

for the Emotional Control subscale, $t(12) = -0.12$, $p = .91$, Situational Responsiveness subscale, $t(12) = 0.77$, $p = .46$, or Self Awareness subscale, $t(12) = 0.94$, $p = .37$.

Broad Behavioral Assessment

Consistent with hypotheses, independent samples *t*-tests indicated that adolescents with ASD significantly differed from their TD peers on all BASC-2 composites and subscales (see Table 5). More specifically, parental report indicated that adolescents with ASD displayed greater hyperactivity, $t(27) = -7.05$, $p < .001$, aggression, $t(27) = -4.44$, $p < .001$, conduct problems, $t(27) = -3.71$, $p = .001$, ($t = -3.71$, $p = .001$), externalizing problems, $t(27) = -5.80$, $p < .001$, anxiety, $t(27) = -3.25$, $p < .005$, depression, $t(27) = -5.05$, $p < .001$, somatization, $t(27) = -2.90$, $p < .01$, internalizing problems $t(27) = -4.83$, $p < .001$, atypicality, $t(27) = -10.43$, $p < .001$, withdrawal, $t(27) = -8.47$, $p < .001$, attention problems, $t(27) = -8.68$, $p < .001$, and behavioral symptoms, $t(27) = -11.43$, $p < .001$, relative to their TD peers. Parents of youth with ASD also reported lower levels of adaptability, $t(27) = 8.42$, $p < .001$, social skills $t(27) = 6.26$, $p < .001$, leadership, $t(27) = 9.10$, $p < .001$, participation in activities of daily living, $t(27) = 5.88$, $p < .001$, functional communication,

$t(27) = 9.72$, $p < .001$, and adaptive skills, $t(27) = 10.37$, $p < .001$.

Following participation in the PEERS training program, adolescents with ASD exhibited significant changes in several BASC-2 subscales. More specifically, parental report revealed improvements in aggression, $t(12) = 2.69$, $p < .05$, anxiety, $t(12) = 3.03$, $p = .01$, withdrawal, $t(12) = 3.00$, $p < .05$, adaptability, $t(12) = -3.96$, $p < .005$, leadership, $t(12) = -2.71$, $p < .05$, and activities of daily living, $t(12) = -2.45$, $p < .05$. In addition, a trend-level effect indicating improvements in broad internalizing problems, $t(12) = 2.15$, $p = .053$, was observed. No other significant differences relative to pre-treatment scores were found.

ASD Symptomatology

As expected, between-subjects analyses indicated that adolescents with ASD significantly differed from their TD peers on all GARS subscales ($p < .001$ for restricted/repetitive behavior, social interaction, social communication, emotional responses, cognitive style, and maladaptive speech). After participation in the PEERS treatment, parental report revealed significant improvements in emotional responsiveness, $t(12) = 2.32$, $p < .05$. Trend-level effects were also found suggesting nonsignificant improvements in restrictive/repetitive behavior, $t(12) = 1.86$, $p = .09$, social

Table 5 Raw scores for parent-report broadband measures of psychological and behavioral functioning for ASD and TD groups

	ASD pre-test		ASD post-test		TD controls		Comparison (<i>t</i>)		
	Mean	SD	Mean	SD	Mean	SD	Pre-TD	Pre-Post	Post-TD ^a
BASC-2									
Externalizing problems composite	190.77	30.35	185.62	29.93	139.08	10.36	-5.80***	1.20	-
Internalizing problems composite	193.31	36.20	183.23	29.29	145.23	15.84	-4.83***	2.15	-
Behavioral symptoms index	427.62	40.80	410.38	48.15	275.08	24.18	-11.43***	1.79	-
Adaptive skills composite	177.46	30.37	189.77	40.22	287.15	27.18	10.37***	-1.75	-
Hyperactivity	11.69	3.25	10.62	3.48	3.15	2.58	7.05***	1.38	-
Aggression	9.08	4.39	7.77	4.34	3.15	1.52	-4.44***	2.69*	-3.62***
Conduct problems	9.38	5.97	8.54	4.89	3.38	1.94	-3.71**	1.42	-
Anxiety	16.00	6.30	13.15	6.09	10.23	3.52	-3.25**	3.03*	-1.50
Depression	14.54	7.57	12.92	6.75	3.77	3.32	-5.05***	1.39	-
Somatization	8.31	5.69	7.62	5.25	3.08	2.33	-2.90**	1.21	-
Atypicality	12.69	2.96	10.92	4.17	1.08	1.38	-10.43***	1.66	-
Withdrawal	15.54	2.88	13.77	3.13	4.15	4.14	-8.47***	3.00*	-6.69***
Attention problems	12.15	2.34	11.31	2.75	3.23	3.14	-8.68***	1.44	-
Adaptability	9.77	3.75	11.85	4.06	19.77	2.42	8.42***	-3.96**	6.05***
Social skills	10.00	3.67	11.62	5.00	17.77	3.37	6.26***	-1.51	-
Leadership	8.23	2.98	10.77	3.79	22.15	4.83	9.10***	-2.71*	6.69***
Activities of daily living	8.77	4.82	9.77	5.20	18.77	3.86	5.88***	-2.45*	5.01***
Functional communication	16.46	4.93	17.38	6.06	32.15	2.73	9.72***	-0.99	-

BASC-2 behavior assessment system for children—second edition

**p* < .05

** *p* < .01

****p* < .001

^aComparisons conducted when variables demonstrated significant pre-/post-intervention changes

interaction, *t*(12)=2.12, *p* = .06, and social communication, *t*(12)=1.97, *p* = .07. Results of these analyses are presented in Table 6.

Extent of Post-intervention Changes

Results of follow-up independent samples *t*-tests between TD and ASD post-treatment scores conducted for those measures that changed significantly pre- to post-intervention were only partially consistent with study hypotheses. With regard to broad social, emotional, and behavioral functioning, when post-intervention BASC-2 scores that were significantly different post-intervention were compared to TD peers, the anxiety subscale was no longer significantly different between ASD and TD groups, *t*(24)=-1.50, *p* = .15. All other subscales remained significantly different between groups (*p* < .001 for aggression, withdrawal, adaptability, leadership, and activities of daily living). Follow-up analyses of significant post-treatment changes on the GARS-3 revealed that emotional responses remained significantly different between ASD post-intervention scores and TD scores, *t*(24)=-4.04, *p* < .001.

Discussion

The current study examined the efficacy of the PEERS social skills training program for improving socio-emotional competencies in adolescents with ASD. Results generally supported study hypotheses (a) adolescents with ASD, relative to matched comparisons with TD, will display clinically significant differences in social and emotional functioning measured at pre-treatment, (b) the 14-week parent-mediated PEERS treatment will have positive effects on the socio-emotional functioning of adolescents with ASD, and (c) the socio-emotional functioning of adolescents with ASD would more closely approximate that of their TD peers measured at post-treatment. With regard to the first hypothesis, convergent results from self- and parent-report behavioral inventories suggested that adolescents with ASD demonstrated significantly more emotional, behavioral, and social difficulties than their TD peers. Specifically, youth with ASD exhibited greater problems across domains of internalizing and externalizing behavior, negative and positive affect, social communication and interaction, social cognition and awareness, and adaptive skills.

Additionally, consistent with our second hypothesis, analyses comparing responses to behavioral inventories pre- and post-treatment revealed significant changes in emotional, behavioral, and social functioning in youth with ASD post-treatment. According to parental report, adolescents with ASD exhibited decreased aggression, anxiety, and withdrawal, in addition to improved adaptability, leadership, and participation in activities of daily living after participating in PEERS. Moreover, significant improvement in emotional responsiveness was observed. Although nonsignificant, notable trend-level effects suggesting socio-emotional and ASD-related behavioral changes were also indicated, including decreased internalizing problems and improvements in restrictive/repetitive behavior, social interaction, and social communication. Regarding our final hypothesis, follow-up analyses for significant pre-/post-intervention changes revealed meaningful improvement in symptoms of anxiety, such that anxiety was no longer significantly different between the post-PEERS ASD and TD groups. This suggests that adolescents with ASD experienced enough improvement in anxiety symptoms from PEERS that they were functioning at the same level as that of their TD peers post-treatment. However, this effect was limited to anxiety, as all other improvements following PEERS remained significantly discrepant from TD peers' functioning.

Interestingly, participation in PEERS did not result in predicted improvements in affect recognition performance post-treatment. This finding may indicate that parent-reported changes in emotional, behavioral, and social functioning in youth with ASD post-intervention do not generalize to more explicit judgments of affective expressions. It is also possible that this task was too easy for the current participants, as the adolescents with ASD did not exhibit expected impairments in these affect recognition abilities relative to their TD peers. Notably, the impact of task complexity has been investigated in previous studies and findings indicate that individuals with high-functioning ASD can identify emotions as well as TD peers under standard viewing conditions, although affect recognition deficits emerge when the conditions are made more difficult. This can be accomplished by incorporating complex emotions (e.g., guilt, shame), presenting conflicting information, or shortening the presentation time (Harms et al. 2010). Thus, it is likely that the affect recognition task used in the current study was too easy and impairments in affect recognition may have emerged for adolescents with ASD with a more complex task. While it is also possible that the inclusion of a small number of 17-year-old participants may have resulted in ceiling effects that contributed to strong affect recognition performance in youth with ASD, this is unlikely as participants were matched between groups and were all within six months of the age range for the measure.

Moreover, affect recognition abilities generally develop prior to the onset of adolescence and have been shown to remain relatively stable after age 12 (Tonks et al. 2009).

More broadly, the literature is mixed with regard to the specific impairments in social perception exhibited by youth with ASD. For example, while Korkman et al. (2007) reported worse affect recognition abilities in youth with ASD, Narzisi et al. (2013) found that understanding of emotional contexts and appropriate affective states was generally intact in youth with high-functioning ASD. Moreover, some studies suggest that affect recognition abilities are more dependent on intellectual ability in youth with ASD than in typical development (Dyck et al. 2006). Our findings support this hypothesis, as the ASD group demonstrated average intellectual functioning that was statistically comparable to that of the TD group. Taken together with the current study, these findings suggest that social deficits in youth with ASD are not a unitary construct, but rather continuously distributed and multifaceted. Thus, it may be that social skills intervention selectively improves specific aspects of emotional, behavioral, and social functioning necessary for developing quality peer relationships and remediating social isolation in this population, with potential for such improvements to approximate typical functioning.

Importantly, results of the current study are consistent with a small body of literature documenting the effectiveness of the PEERS treatment for improving socio-emotional competencies in adolescents with ASD. To date, the bulk of empirical support for the PEERS program has been comprised of self- and parent-reported changes in social skills and social functioning post-treatment (Laugeson et al. 2012, 2009). Results from the current study not only corroborate previous findings, but also help to characterize changes in broader emotional, behavioral, and adaptive functioning following participation in PEERS treatment which suggest that social skills training is more broadly impactful for youth with ASD. Moreover, our findings suggest that PEERS may be particularly effective for improving certain aspects of socio-emotional functioning, such as anxiety. Taken together, these findings highlight the importance of more comprehensively assessing all changes associated with response to treatment and better elucidating treatment outcomes in this population.

Limitations

Although encouraging, findings presented in the current study must be interpreted in light of several limitations. First, the study sample was relatively homogeneous with respect to racial and ethnic background. Specifically, 23 of the 26 participants were Caucasian, which limits the generalizability of these findings to individuals of similar

Table 6 Raw scores for parent-report measures of characteristic behaviors of ASD for ASD and TD groups

	ASD pre-test		ASD post-test		TD Controls		Comparison (<i>t</i>)		
	Mean	SD	Mean	SD	Mean	SD	Pre-TD	Pre-Post	Post-TD ^a
GARS-3									
Restrictive/ repetitive behaviors	15.15	6.61	12.77	7.35	4.15	0.38	-7.00***	1.86	-
Social interac- tion	24.15	12.41	17.15	5.57	3.54	0.66	-9.36***	2.12	-
Social commu- nication	19.85	6.27	18.08	6.85	2.15	0.38	-9.29***	1.97	-
Emotional responses	12.54	5.16	9.54	6.78	3.46	0.66	-7.54***	2.32*	-4.04***
Cognitive style	14.46	3.89	12.31	4.25	7.85	1.63	-5.26***	1.66	-
Maladaptive speech	7.15	4.12	6.23	3.94	5.08	0.28	-6.48***	1.56	-

GARS-3 gilliam autism rating scale—third edition

* $p < .05$

** $p < .01$

*** $p < .001$

^aComparisons conducted when variables demonstrated significant pre-/post-intervention changes

racial and ethnic backgrounds. Second, although the overall sample size ($N=29$) was moderate, certain statistical analyses were performed on smaller subsets of the sample. For example, pre- and post-treatment comparisons in adolescents with ASD were examined for only 13 youth. This attenuated statistical power in these analyses, likely limiting the number of significant findings observed. Third, adolescents in the ASD group returned for the follow-up study session an average of 21 weeks ($M=21.24$, $SD=7.24$) after completing the first PEERS session and 7 weeks after completing the final PEERS session ($M=7.24$, $SD=5.15$). This presents a possible confound as the effects observed in the current study may have been due to factors other than participation in PEERS treatment, such as neurobiological or socio-environmental changes associated with development during adolescence. Relatedly, pre- and post-treatment comparisons were only conducted for adolescents with ASD, and it will be important for future studies to include repeated assessments of TD adolescents in order to help dissociate changes due to participation in PEERS treatment from changes associated with development during adolescence.

Finally, the high prevalence of comorbid psychiatric diagnoses (75%) and psychotropic medications (37.5%) in the ASD group complicates the interpretability of study findings. Prior to study initiation, the decision was made to prioritize external validity and maintain consistency with eligibility criteria for the PEERS training program by not excluding adolescents with comorbid psychiatric conditions. However, this necessarily resulted in a concomitant

decrease in the internal validity of the study by introducing potential confounds. For example, results indicated that the overwhelming majority of youth with ASD reporting a comorbid psychiatric condition were diagnosed with ADHD, and six of these youth were also taking stimulant medications. Youth with ADHD have been previously shown to demonstrate atypical social and emotional functioning relative to their TD peers (Collin et al. 2013; Uekermann et al. 2010). However, Salley et al. (2015) examined communication and social interaction skills in youth with ASD, ADHD, and ASD+ADHD and found clear disassociations between these groups. In particular, youth with ASD demonstrated greater deficits in social communication and interaction than youth with ADHD. Youth with comorbid ASD+ADHD were found to demonstrate the unique deficits of both disorders, but no additive or interaction effects. Similarly, Tye et al. (2014) examined affect processing in youth with ASD, ADHD, and ASD+ADHD and found discrete deficits associated with both disorders, but no additive or interaction effects for youth with comorbid ASD+ADHD. Thus, the high prevalence of comorbid ADHD in the current study, while a confound, is unlikely to account for study findings.

Conclusion and Future Directions

In conclusion, the PEERS social skills treatment led to improvements in social and emotional functioning in adolescents with ASD. These findings are promising and

suggest that social skills intervention may selectively improve particular aspects of emotional, behavioral, and social functioning necessary for enhancing socio-emotional competencies and remediating social deficits in adolescents with ASD. Nonetheless, the current study should be replicated in a larger, more representative sample, with repeated assessments of TD adolescents, and further examination of psychiatric comorbidities in youth with ASD. As task demands may contribute to the null findings concerning affect recognition in youth with high-functioning ASD, future studies should incorporate more complex and dynamic stimuli as compared to the static, prototypical faces used in the current study. Furthermore, investigations would benefit from examining additional neuropsychological variables related to socio-emotional cognition, such as social perception, social language, theory of mind, and emotional face processing. Specific measures to assess such variables include the NEPSY-II Theory of Mind subtest as well as the Social Language Development Test (Adolescent Version; Bowers et al. 2010). Finally, expanding knowledge about the relative sensitivity and specificity of particular social and emotional processes that are susceptible to psychosocial intervention would help isolate the therapeutic mechanisms that contribute to positive treatment outcomes in this population, both those associated with PEERS and with broader forms of treatment.

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Author Contributions DL participated in the study's data collection and design as well as coordinated and drafted the manuscript; MB conceived of the study, participated in its design and measurement, and helped draft the manuscript; ES helped to draft the manuscript; CK performed the statistical analyses; BB conceived of the study and participated in its design and coordination; DAS supervised the study and manuscript drafts. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of interest All authors declare no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th edn.). Arlington: American Psychiatric Publishing.
- Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioning children with autism. *Child Development, 71*, 447–456. doi:10.1111/1467-8624.00156.
- Bellini, S., Peters, J. K., Benner, L., & Hopf, A. (2007). A meta-analysis of school-based social skills interventions for children with autism spectrum disorders. *Remedial and Special Education, 28*(3), 153–162.
- Bohlander, A. J., Orlich, F., & Varley, C. K. (2012). Social skills training for children with autism. *Pediatric Clinics of North America, 59*(1), 165–174. doi:10.1016/j.pcl.2011.10.001.
- Bonneh, Y. S., Levanon, Y., Dean-Pardo, O., Lossos, L., & Adini, Y. (2011). Abnormal speech spectrum and increased pitch variability in young autistic children. *Frontiers in Human Neuroscience, 4*(237), 1–7. doi:10.3389/fnhum.2010.00237.
- Bowers, L., Huisingsh, R., & LoGiudice, C. (2010). *Social language development test manual*. Austin: LinguiSystems.
- Chang, Y., Laugeson, E. A., Gantman, A., Ellingsen, R., Frankel, F., & Dillon, A. R. (2013). Predicting treatment success in social skills training for adolescents with autism spectrum disorders: The UCLA program for the education and enrichment of relational skills. *Autism, 1–4*. doi:10.1177/1362361313478995.
- Collin, L., Bindra, J., Raju, M., Gillberg, C., & Minnis, H. (2013). Facial emotion recognition in child psychiatry: a systematic review. *Research in Developmental Disabilities, 34*(5), 1505–1520. doi:10.1016/j.ridd.2013.01.008.
- Dawson, G., & Burner, K. (2011). Behavioral interventions in children and adolescents with autism spectrum disorder: A review of recent findings. *Current Opinion in Pediatrics, 23*, 616–620. doi:10.1097/MOP.0b013e32834cf082.
- Dawson, G., Toth, K., Abbott, R., Osterling, J., Munson, J., Estes, A., & Liaw, J. (2004). Early social attention impairments in autism: Social orienting, joint attention, and attention to distress. *Developmental Psychology, 40*, 271–283. doi:10.1037/0012-1649.40.2.271.
- Dawson, G., Webb, S. J., & McPartland, J. (2005). Understanding the nature of face processing impairment in autism: Insights from behavioral and electrophysiological studies. *Developmental Neuropsychology, 27*(3), 403–424. doi:10.1207/s15326942dn2703_6.
- Dyck, M. J., Piek, J. P., Hay, D., Smith, L., & Hallmayer, J. (2006). Are abilities abnormally interdependent in children with autism? *Journal of Clinical Child & Adolescent Psychology, 35*(1), 20–33. doi:10.1207/s15374424jccp3501_3.
- Ebesutani, C., Okamura, K., Higa-McMillan, C., & Chorpita, B. F. (2011). A psychometric analysis of the positive and negative affect schedule for children–parent version in a school sample. *Psychological Assessment, 23*(2), 406. doi:10.1037/a0022057.
- Gaigg, S. B. (2012). The interplay between emotion and cognition in autism spectrum disorder: Implications for developmental theory. *Frontiers in Integrative Neuroscience, 6*(113), 1–35. doi:10.3389/fmint.2012.00113.
- Geschwind, D. H. (2009). Advances in autism. *Annual Review of Medicine, 60*, 367–380. doi:10.1146/annurev.med.60.053107.121225.
- Gilliam, J. E. (2014). *Gilliam autism rating scale—third edition manual*. Lutz: PAR Inc.
- Gresham, F. M., & Elliott, S. (1990). *The social skills rating system*. Circle Pines: American Guidance Service.
- Harms, M. B., Martin, A., & Wallace, G. L. (2010). Facial emotion recognition in autism spectrum disorders: A review of behavioral

- and neuroimaging studies. *Neuropsychology Review*, 20, 290–322. doi:10.1007/s11065-010-9138-6.
- Harrison, P. L., & Oakland, T. (2003). *Adaptive behavior assessment system* (2nd edn.). Los Angeles: Western Psychological Services.
- Kasari, C., Dean, M., Kretzmann, M., Shih, W., Orlich, F., Whitney, R., ... King, B. (2016). Children with autism spectrum disorder and social skills groups at school: a randomized trial comparing intervention approach and peer composition. *Journal of Child Psychology and Psychiatry*, 57(2), 171–179. doi:10.1111/jcpp.12460
- Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY-II: Clinical and interpretive manual*. San Antonio: The Psychological Corporation.
- Laugeson, E., & Frankel, F. (2010). *Social skills for teenagers with developmental and autism spectrum disorders: The PEERS treatment manual*. New York: Routledge.
- Laugeson, E., Frankel, F., Mogil, C., & Dillon, A. (2009). Parent assisted social skills training to improve friendships in teens with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 39, 596–606. doi:10.1007/s10803-008-0664-5.
- Laugeson, E. A., Ellingsen, R., Sanderson, J., Tucci, L., & Bates, S. (2014). The ABC's of teaching social skills to adolescents with autism spectrum disorder in the classroom: The UCLA PEERS program. *Journal of Autism and Developmental Disorders*, 1–13. doi:10.1007/s10803-014-2108-8.
- Laugeson, E. A., Frankel, F., Gantman, A., Dillon, A. R., & Mogil, C. (2012). Evidence-based social skills training for adolescents with autism spectrum disorders: The UCLA PEERS program. *Journal of Autism and Developmental Disorders*, 42, 1025–1036. doi:10.1007/s10803-011-1339-1.
- Lerner, M. D., White, S. W., & McPartland, J. C. (2012). Mechanisms of change in psychosocial interventions for autism spectrum disorders. *Dialogues in Clinical Neuroscience*, 14, 307–318.
- Levy, A., & Perry, A. (2011). Outcomes in adolescents and adults with autism: A review of the literature. *Research in Autism Spectrum Disorders*, 5, 1271–1282. doi:10.1016/j.rasd.2011.01.023.
- MacDermott, S. T., Gullone, E., Allen, J. S., King, N. J., & Tonge, B. (2010). The emotion regulation index for children and adolescents (ERICA): a psychometric investigation. *Journal of Psychopathology and Behavioral Assessment*, 32(3), 301–314. doi:10.1007/s10862-009-9154-0.
- Magiati, I., Tay, X. W., & Howlin, P. (2012). Early comprehensive interventions for children with autism spectrum disorders: A critical synthesis of recent review findings. *Neuropsychiatry*, 2(6), 543–570. doi:10.2217/npj.12.59.
- Magiati, I., Tay, X. W., & Howlin, P. (2014). Cognitive, language, social and behavioural outcomes in adults with autism spectrum disorders: a systematic review of longitudinal follow-up studies in adulthood. *Clinical Psychology Review*, 34, 73–86. doi:10.1016/j.cpr.2013.11.002.
- Mandelberg, J., Frankel, F., Cunningham, T., Gorospe, C., & Laugeson, E. A. (2014). Long-term outcomes of parent-assisted social skills intervention for high-functioning children with autism spectrum disorders. *Autism*, 18(3), 255–263. doi:10.1177/1362361312472403.
- Mazefsky, C. A., Herrington, J., Siegel, M., Scarpa, A., Maddox, B. B., Scahill, L., & White, S. W. (2013). The role of emotion regulation in Autism Spectrum Disorders. *Journal of the American Academic of Child and Adolescent Psychiatry*, 52(7), 679–688. doi:10.1016/j.jaac.2013.05.006.
- McMahon, C. M., Lerner, M. D., & Britton, N. (2013). Group-based social skills interventions for adolescents with higher-functioning autism spectrum disorder: A review and looking to the future. *Adolescent Health, Medicine and Therapeutics*, 4, 23–38. doi:10.2147/AHMT.S25402.
- Miller, A. R., Vernon, T. W., Wu, V., Russo, K. (2014). Social skill group interventions for adolescents with autism spectrum disorders: A systematic review. *Review Journal of Autism and Developmental Disorders*. doi:10.1007/s40489-014-0017-6.
- Narzisi, A., Muratori, F., Calderoni, S., Fabbro, F., & Urgesi, C. (2013). Neuropsychological profile in high functioning autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 43, 1895–1909. doi:10.1007/s10803-012-1736-0.
- Rao, P. A., Beidel, D. C., & Murray, M. J. (2008). Social skills interventions for children with Asperger's syndrome or high-functioning autism: A review and recommendations. *Journal of Autism and Developmental Disorders*, 38, 353–361. doi:10.1007/s10803-007-0402-4.
- Reichow, B. (2012). Overview of meta-analyses on early intensive behavioral intervention for young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 42, 512–520. doi:10.1007/s10803-011-1218-9.
- Reynolds, C. R., & Kamphaus, R. W. (2004). *Behavior assessment system for children—second edition (BASC-2)*. Circle Pines: AGS.
- Salley, B., Gabrielli, J., Smith, C. M., & Braun, M. (2015). Do communication and social interaction skills differ across youth diagnosed with autism spectrum disorder, attention-deficit/hyperactivity disorder, or dual diagnosis? *Research in Autism Spectrum Disorders*, 20, 58–66. doi:10.1016/j.rasd.2015.08.006.
- Schohl, K. A., Van Hecke, A. V., Carson, A. M., Dolan, B., Karst, J., & Stevens, S. (2014). A replication and extension of the PEERS intervention: Examining effects on social skills and social anxiety in adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44, 532–545. doi:10.1007/s10803-013-1900-1.
- Tierney, C. D., Kurtz, M., Panchik, A., & Pitterle, K. (2014). Look at me when I am talking to you: Evidence and assessment of social pragmatics interventions for children with autism and social communication disorders. *Current Opinion in Pediatrics*, 26, 259–264. doi:10.1097/MOP.0000000000000075.
- Tonks, J., Williams, W. H., Frampton, I., Yates, P., & Slater, A. (2007). Assessing emotion recognition in 9–15-year olds: Preliminary analysis of abilities in reading emotion from faces, voices and eyes. *Brain Injury*, 21(6), 623–629. doi:10.1080/02699050701426865.
- Tse, J., Strulovitch, J., Tagalakakis, V., Meng, L., & Fombonne, E. (2007). Social skills training for adolescents with Asperger's syndrome and high functioning autism. *Journal of Autism and Developmental Disorders*, 37, 1960–1968. doi:10.1007/s10803-006-0343-3.
- Tye, C., Battaglia, M., Bertolotti, E., Ashwood, K. L., Azadi, B., Asherson, P., ... McLoughlin, G., (2014). Altered neurophysiological responses to emotional faces discriminate children with ASD, ADHD and ASD + ADHD. *Biological Psychology*, 103, 125–134. doi:10.1016/j.biopsycho.2014.08.013.
- Uekermann, J., Kraemer, M., Abdel-Hamid, M., Schimmelmann, B.G., Hebebrand, J., Daum, I., & Wiltfang, B.K. (2010). Social cognition in attention-deficit hyperactivity disorder (ADHD). *Neuroscience and Biobehavioral Review*, 34, 734–743. doi:10.1016/j.neubiorev.2009.10.009.
- Van Hecke, A. V., Stevens, S., Carson, A. M., Karst, J. S., Dolan, B., Schohl, K., & Brockman, S. (2013). Measuring the plasticity of social approach: A randomized controlled trial of the effects of the PEERS intervention on EEG asymmetry in adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 1–20. doi:10.1007/s10803-013-1883-y.
- Walton, K. M. & Ingersoll, B. R. (2013). Improving social skills in adolescents and adults with autism and severe to profound intellectual disability: A review of the literature. *Journal of Autism*

- and Developmental Disorders*, 43, 594–615. doi:[10.1007/s10803-012-1601-1](https://doi.org/10.1007/s10803-012-1601-1).
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. doi:[10.1037/0022-3514.54.6.1063](https://doi.org/10.1037/0022-3514.54.6.1063).
- Wechsler, D. (2011). *Wechsler abbreviated scale of intelligence—second edition manual*. Bloomington: Pearson.
- White, S. W., Keonig, K., & Scahill, L. (2007). Social skills development in children with autism spectrum disorders: a review of the intervention research. *Journal of Autism and Developmental Disorders*, 37(10), 1858–1868. doi:[10.1007/s10803-006-0320-x](https://doi.org/10.1007/s10803-006-0320-x).
- White, S. W., Ollendick, T., Albano, A. M., Oswald, D., Johnson, C., Southam-Gerow, M. A., ... Scahill, L. (2013). Randomized controlled trial: Multimodal anxiety and social skill intervention for adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 43, 382–394. doi:[10.1007/s10803-012-1577-x](https://doi.org/10.1007/s10803-012-1577-x).
- Yoo, H., Bahn, G., Cho, I., Kim, E., Kim, J., Min, J., ... Laugeson, E.A. (2014). A randomized controlled trial of the Korean version of the PEERS parent-assisted social skills training program for teens with ASD. *Autism Research*, 7, 145–161. doi:[10.1002/aur.1354](https://doi.org/10.1002/aur.1354).